Budget Item	Program Title	Budget Request
A08b	**Air Traffic Control/Airway Facilities Human Factors**	$9,968,000

GOALS:

Intended Outcomes: The FAA intends to improve air traffic control safety by:

- Developing more effective methods for investigating, reporting, and analyzing operational errors and deviations.
- Developing human factors educational aids to mitigate runway incursions and underlying human performance issues.
- Developing human factors educational aids to mitigate controller fatigue resulting from shiftwork.
- Increasing human factors considerations in the acquisition and design of air traffic control automation systems.
- Improving techniques for identifying worforce requirements and selecting applicants for Air Traffic and Airway Facilities positions.

Agency Outputs: Human factors problems in today's operations involve human performance constraints and other human factors issues that pose risk to the acquisition of Air Traffic Control (ATC) systems. The study of the relationship between shiftwork schedules and fatigue is identifying techniques for mitigating impacts on controller performance. Taxonomic analysis of operational errors is identifying improvements in how errors are investigated and reported, which in turn is leading to more effective safety interventions. Human factors research provides guidelines and other information for the design and development of ATC systems and product improvements. Tests and criteria for the selection of operational personnel improve applicant screening efficiency and validity.

Customer/Stakeholder Involvement: The ATC/Airways Facilities (AF) Human Factors Research Program Research Program is directly tied to the following ARA Safety Performance Goals:

Goal 1. *Aviation Safety:* In support of the FAA's mission goal related to system safety, contribute to the FAA goal to reduce the fatal aviation accident rate 80% by FY 2007 as compared to 1994-1996 baseline data.

Goal 2. *Human Factors:* In support of FAA's performance goals, ARA will, by FY 2005, ensure human factors policies, processes, and best practices are integrated in the research and acquisition of 100

percent of FAA aviation systems and applications. Two implementation strategies entail research on NAS integration and human error that contribute to acquisition programs, and acquisition activities associated with the analysis, design, development, testing, deployment, and implementation of FAA systems and applications.

The ATC/AF Human Factors Research Program is the product of continued cooperation and collaboration between the Office of the Chief Scientific and Technical Advisor for Human Factors (AAR-100) and its customer base, the Air Traffic Requirements Service (ARS). The detailed research portfolio is coordinated with several organizational elements: Plans and Performance Directorate (ARX-20); Resource Management Program (AFZ-100); NAS Operations (AOP-30); Air Traffic Procedures (ATP-400), and the Air Traffic Services Office of Evaluations and Investigations (AAT-20). In addition, Integrated Product Teams in the Office of Communication, Navigation, and Surveillance Systems (AND), and the Office of Air Traffic Systems Development (AUA) share in identifying research requirements through AAR-100 representatives. Projects are coordinated with the Offfice of System Architecture and Investment Analysis (ASD-130).

Human Factors research is grounded in addressing issues that emerge from the FAA's Operations Concept for 2005. The program draws on the NAS Architecture Version 4.0 that specifies: "a broad range of research activities regarding the implications of human factors". Research activities will develop the information necessary to understand human capabilities and limitations in each functional area. Human factors engineering will then be applied to identify and resolve risks, and to assess costs, benefits, and trade-offs.

The ATC/AF Human Factors Research Program is responsive to the recommendations of the congressionally mandated Research, Engineering, and Development Advisory Committee (REDAC). The REDAC recommended: "work on broader, more fundamental issues: effects of stress with increased workload; introducing new systems in the heavily-loaded ATC environment; sharing responsibility between controller and pilot; and the human as a monitor of highly-automated systems."

Central to this research program is the joint FAA, NASA, and DOD *National Plan for Civil Aviation Human Factors: An Initiative for Research and Application* published in 1995. This document outlines a coherent national agenda for human factors research and

application leading to significant improvements in NAS safety and efficiency. Human factors research is organized around the following four thrusts:

- *Information Management and Display* - Determine what, when, and how one might best display and transfer information to system components; design the system to reduce the frequency of information transfer errors; and minimize the impact when such errors do occur.
- *Human-Centered Automation* - Keep the operator in-the-loop and situationally aware of automated system performance while balancing operator workload; resolve issues related to the degradation of basic skills should the automation fail.
- *Human Performance Assessment* - Identify the intrinsic characteristics of individuals and teams that determine how well they are able to perform tasks; characterize the impact of environmental and individual factors on human performance; and improve and standardize methods for measuring human performance.
- *Selection and Training* - Assess the knowledge and skills needed to excel in highly automated environments including impacts of new technology.

Accomplishments: The program has supported the following research with resulting products:

Information Management and Display

- Standard Terminal Automation Replacement System (STARS) - Conducted comprehensive assessment of the STARS operational radar display and maintenance control workstations. A related initiative yielded a definitive process to integrate human factors in other NAS acquisitions.

- Guidelines on use of Color in ATC Displays – Provided Integrated Product Teams (IPTs) reference guidance on the most effective uses for color coding operational information in new system displays.

Human-Centered Automation
- Flight Strip Studies – Identified operational functions in controller use of paper flight progress strips to support transition to Free Flight Phase 1 decision support automation.
- Auditory Alarm Database – Developed database of alarms for use in the design of future AF alerting systems for centralized maintenance centers.

Human Performance and Assessment

- Air Traffic Control Specialist (ATCS) Shift Work Schedules – Completed first element of Congressionally mandated study through a survey addressing controller shiftwork, fatigue, and performance.

- Runway Incursion Human Factors Workshop – Completed workshop involving government, industry, and academic pespectives leading to the definition of research needs addressing performance risks and airport complexity factors.

- Flight Service Station Operational and Supportability Implementation System (OASIS) Study – Conducted virtual reality ergonomic evaluation of proposed workstations.

- Impact of Shared Separation on ATCS Situation Awareness – Conducted study of impacts from distributed air/ground separation responsibility on air traffic controller performance.

- Human factors booklet for controllers. This brochure provides controllers with helpful information about human factors they can use to enhance job performance.

- Report on the impact of airspace restructuring on air traffic controller performance.

Selection and Training

- Variable Item Generator (VIGOR) for Personnel Selection – Prototyped proof-of-concept computer tool to generate knowledge test items for screening applicants for Airway Facilities positions.

- Basic Electronic Specialist Test (BEST) – Developed screening test for selection of AF new hires, with an estimated savings of $3-5 million/year in reduced training costs.

R&D Partnerships: Coordinated research is conducted with NASA Ames in the areas of distributed air/ground separation responsibility and human error, and with the Naval Research Laboratory regarding enhanced vision technology for towers. Internationally, part of the joint FAA-EUROCONTROL Action Plan 12 for the management and reduction of human error involves harmonizing research methods for operational errors.

MAJOR ACTIVITIES AND ANTICIPATED FY 2001 ACCOMPLISHMENTS:

Information Management and Display
- Human Factors Design Guide (HFDG) – Update of the HFDG provides Integrated Product Teams with guidelines for effective human factors design of

automation and communication/navigation/ surveillance technologies.

- Computer-Human Interface (CHI) Integration – Report for Integrated Product Teams on identified CHI inconsistencies between designs of legacy systems and anticipated product improvements and other subsystems to be integrated as part of NAS evolution.

- AF Visual Symbology – Report to AOP on human factors design guidance and CHI inconsistencies in the NAS Infrastructure Management System (NIMS).

Human-centered Automation

- Flight Strip Replacement – Assess controller operational requirements in use of paper flight progress strips in en route and approach transitions in support of Free Flight Phase 1 decision support automation.

- Enhanced Vision Systems – Demonstration of enhanced vision technology under reduced visibility conditions to support tower controller information requirements.

Human Performance and Assessment

- Controller Alternative Work Schedules – Complete the second element of the Congressionally mandated study through field biomedical studies of controller work schedules and rest cycles.

- Runway Safety Booklet – Booklet of informative human factors information for controllers and pilots to help prevent runway incursions addressing communications, attention and memory, and threats to performance.

- Display System Replacement (DSR) Comparison - Report on comparison of task load and performance measures for pre- and -post Display System Replacement (DSR) implementation.

- Sector Team Communications - Baseline assessment of sector team communication and controller coordination from transition to conflict probe.

Selection and Training

- Prototype Air Traffic Applicant Screening System – Development of a prototype biographical assessment tool for screening job applicants.

- Validation of Airway Facilities Basic Electronics Screening Tool (BEST) – Completion of a formal validation of BEST relative to available criteria to

screen job applicants. BEST offers the potential to save $3-5 million/year in reduced training costs.

KEY FY 2002 PRODUCTS AND MILESTONES:

ATS-related research within the National Plan research thrusts include:

Information Management and Display

- Computer-Human Interface (CHI) Integration – Detailed assessments of CHI inconsistencies between designs of en route and oceanic legacy systems and anticipated product improvements and other subsystems to ensure compatibility with design guidelines and human performance considerations.

- Information management in AF systems - Assessment for improving information transfer and display to support system specialist and team performance in the AF environment.

Human-centered Automation

- Reduction in use of paper flight progress strips - Refinements to automation, procedures and training to facilitate reducing the operational need for paper flight progress strips will be developed.

- Situational awareness in centralized monitor and control - Determine what information and feedback is necessary for AF System Specialists to stay aware of automated processes in relation to workload, performance, and error mitigation.

Human Performance and Assessment

- Examination of causal factors related to operational errors - This project is targeted at reducing operational errors and deviations through the understanding and mitigation of causal factors.

- ATC sector teamwork and collaborative decision-making - Assess how enhanced decision support and automated coordination tools affect intra- and inter-sector communications and coordination.

- Shift work and fatigue - This research will assess the fatigue countermeasure recommendations developed by the Scientific Steering Group as based on findings from the Congressionally mandated research on shift patterns.

- POWER task load and performance baseline assessments – Assess the utility of POWER's objective metrics to define and assess expert controller performance with baseline systems.

- Team processes in centralized monitor and control systems - Develop team and organizational guidelines to enhance effective team operations.
- Organizational assessment - Assess human factors issues and successful organizational practices in developing a Model Work Environment.

Selection and Training

- Develop and validate computerized application evaluation systems – Develop new, make technical enhancements, and continue longitudinal validation of screening and text tools for selection of applicants into ATC, En route Traffic (ET), and Air Traffic Services (ATS) positions.

- Develop a prototype workforce analysis tool - This application will support the identification and analysis of gaps between current and future workforce skills and staffing profiles.

FY 2002 PROGRAM REQUEST

The FY 2002 program supports ATS with research to address human performance over the next several years. Research projects will focus on providing timely information to answer critical human factors questions.

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APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2000)	$100,785
FY 2001 Enacted	8,000
FY 2002 Request	9,968
Future Requirement	TBD
Total	$118,753

Budget Authority ($ 000)	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Request
Contracts					
Air Traffic Control/Airway Facilities Human Factors	5,454	5,711	1,661	2,295	4,229
Personnel Costs	3,773	3,117	5,034	3,984	4,069
Other Inhouse Costs	773	1,172	1,305	1,721	1,670
Total	**10,000**	**10,000**	**8,000**	**8,000**	**9,968**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Request
Basic	-	-	-	-	-
Applied	10,000	10,000	8,000	8,000	9,968
Development (includes prototypes)	-	-	-	-	-
Total	**10,000**	**10,000**	**8,000**	**8,000**	**9,968**